National Unit Specification: general information

UNIT Electrical Testing and Measurement (SCQF level 5)

CODE F5HM 11

SUMMARY

This Unit is designed for candidates with little or no prior knowledge of electrical testing and measurement but who wish to develop knowledge and skills in this important area of electrical engineering. The Unit is suitable for those candidates training to be an electrical craftsperson or technician.

On successful completion of this Unit candidates should be able to use electrical test equipment to make correct and safe measurements in electrical circuits and installations.

This Unit may form part of an National Qualification Group Award or may be offered on a free-standing basis.

OUTCOMES

1 State the features of electrical measuring instruments and their sources of error.
2 Carry out current and voltage measurements in direct current (dc) and alternating current (ac) networks.
3 Carry out resistance measurements in electrical circuits and electrical installations.
4 Carry out power measurements in dc circuits.

Administrative Information

Superclass: XJ

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National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Standard Grade Physics and/or Technological Studies — General Level
- NQ Unit *Electrical Fundamentals* at SCQF level 5

CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- Problem Solving (SCQF level 5)
- Numeracy (SCQF level 5)
- Working with Others (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

State the features of electrical measuring instruments and their sources of error.

Performance Criteria

(a) State correctly the differences between analogue and digital measuring instruments.
(b) State correctly different types of analogue instruments.
(c) State correctly sources of error in electrical measurement in terms of the limitations of the instrument used, operator error and the impact of the instrument on the circuit.
(d) State correctly the advantages of digital instruments over analogue instruments.
(e) State correctly safety precautions that should be adopted when using electrical measuring instruments.

OUTCOME 2

Carry out current and voltage measurements in dc and ac networks.

Performance Criteria

(a) State correctly the definitions of current and voltage.
(b) Carry out accurately and safely voltage and current measurements in a series — parallel resistance network supplied from a dc voltage source.
(c) Carry out accurately and safely voltage and current measurements in a series — parallel resistance network supplied from an ac voltage source.
(d) Describe correctly any sources of error that may arise as a result of making voltage and current measurements in electrical networks.

OUTCOME 3

Carry out resistance measurements in electrical circuits and electrical installations.

Performance Criteria

(a) State correctly the definition of electrical resistance.
(b) Explain correctly the difference between resistance as a lumped and distributed quantity.
(c) Measure accurately and safely lumped resistances in an electrical network using the ammeter voltmeter method.
(d) Compare the results, including sources of error of making resistance measurements using the ammeter voltmeter method with measurements made using an instrument that can measure resistance directly.
(e) Carry out accurately and safely a continuity test and an insulation resistance measurement on an electrical installation.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Carry out power measurements in dc circuits.

Performance Criteria

(a) Carry out accurately and safely measurement of power in a dc electrical network using an ammeter and voltmeter.
(b) State correctly any sources of error that arise as a result of using an ammeter and voltmeter to measure power in a dc electrical circuit.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate the candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence and performance evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria.

Safety should be emphasised throughout the delivery of the Unit. All wiring and measurements must be undertaken in a safe manner.

Outcome 1 (written and/or recorded oral evidence)

The evidence for Outcome 1 should be produced under controlled, supervised, closed-book conditions in which candidates should not be permitted to bring any notes, handouts, textbooks into the assessment event. The assessment event should last 30 minutes.

With regard to Outcome 1 candidates should state:

- three analogue instruments
- two sources of error under each category
- three advantages of digital instruments over analogue instruments
- three safety precautions

Outcomes 2, 3 and 4 (performance evidence, written and/or recorded oral evidence)

The evidence for Outcomes 2, 3 and 4 should be produced under supervised conditions in a practical electrical environment(s). The total assessment time for the three Outcomes should not exceed 1 hour 30 minutes.

With regard to Outcome 2 candidates should make:

- two current and voltage measurements

National Unit Specification: statement of standards (cont)

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With regard to Outcome 3 candidates should make:

- two resistance measurements

With regard to Outcome 4 candidates should make

- two power measurements

For those Performance Criteria in Outcomes 2, 3 and 4 requiring a statement or explanation, evidence should be produced either orally or in writing. Candidate evidence could be gathered as part of the practical exercises undertaken by the candidates throughout the delivery of the Unit. Where candidates are working in groups, assessors must satisfy themselves that each candidate is satisfactorily meeting the Performance Criteria for each Outcome.

The Assessment Support Pack for this Unit provides sample assessment materials. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a mandatory Unit within the National Certificate in Electrical Engineering at SCQF level 5. This Unit can also be delivered on a free-standing basis.

The aim of the Unit is to allow candidates to develop the knowledge, understanding, skills and confidence to make accurate and safe measurements of dc voltages and currents, ac voltages and currents, resistance and dc power in electrical networks. Candidates will also learn how to undertake continuity and insulation resistance measurements in electrical installations.

Centres may wish to provide candidates with an induction session at the start of the Unit into the safe use of electricity and electrical instruments. However, safety should be emphasised throughout the delivery of the Unit. Candidates should be trained to lift and transport electrical instruments with care and not leave them in situations where they could be dangerous to the candidate or others or where they could be damaged. It is strongly advised that candidates are not allowed to energise electrical circuits and make measurements until circuits have been checked by their lecturer.

Although it is very important that candidates make correct and safe electrical measurements, the focus should be on encouraging candidates to understand that no electrical measurement is absolutely accurate. Candidates need to learn that any electrical measurement may be subject to error. They need to know and understand what gives rise to these sources of error and that any electrical measurement may need to include a +/- tolerance.

There may be opportunities to integrate this Unit with some of the Electrical Principles Units in the National Certificate in Electrical Engineering at SCQF level 5.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit may be delivered by a combination of lectures, demonstrations and candidate practical exercises done individually or as part of a group. The Unit could be delivered in an electrical laboratory and/or electrical installation workshop. Good diagrams, wall charts and other forms of visual aids will help candidates to learn how electrical instruments work and how they should be connected to electrical circuits. The Internet also provides a rich source of information on electrical instruments and how electrical measurements are made.

National Unit Specification: support notes (cont)

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OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill of *Problem Solving*, that is, planning and organising, critical thinking, reviewing and evaluating, will be developed and enhanced as candidates undertake the practical testing exercises. Identifying and taking account of the complete range of factors influencing the safe use of electrical equipment is essential. Analysing potential sources of error, candidates must select appropriate equipment and work efficiently and safely. Group working and discussions with the assessor could be useful in supporting analytical evaluation of proposed approaches and review of achievements.

As they demonstrate effective working practice candidates perform a series of calculations and measurements. *Numeracy* skills should be naturally enhanced, with the focus throughout on practical interpretation and use of number and graphics. Formative practical activities could be designed to develop accuracy and confidence in a specific electrical engineering context.

There could be opportunities to additionally enhance co-operative group working skills as candidates discuss and undertake practical activities in a workshop environment, if the class is encouraged to:

- analyse the tasks involved in electrical testing and measurement and formally identify the elements involved
- negotiate the nature and scope of goals, roles and responsibilities in a group activity taking account strengths and weaknesses of individuals
- support co-operative working by providing advice and support to each other
- referring to evidence review and evaluate their own contribution to the activities

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Formative assessment exercises involving candidates in wiring circuits, taking electrical measurements and analysing sources of error, should play a particularly important role in allowing candidates to develop knowledge, understanding, skills and confidence in doing electrical testing and measurement work

Centres should take every opportunity to integrate assessment. For example, the measurement of direct currents and voltages in the series-parallel network in Outcome 2, the measurement of lumped resistance in Outcome 3 and the measurement of power in a dc network in Outcome 4 could be undertaken within one combined practical assignment.

National Unit Specification: support notes (cont)

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The suggested approach to assessment in this Unit is as follows:

Outcome 1	an assessment paper comprising of a combination of short answer and restricted response questions taken at a single assessment event lasting 30 minutes. This assessment event should be conducted under controlled, supervised, closed-book conditions in which candidates should not be allowed to bring any notes, handouts or textbooks into the assessment.
Outcomes 2, 3 and 4	a series of practical electrical exercises conducted under supervised conditions. It is left to centres to decide the number of practical electrical exercises they require candidates to undertake to cover the various Performance Criteria in the three Outcomes. Total assessment time for the practical exercises should not exceed 1 hour 30 minutes.

Where candidates work in groups when undertaking practical exercises centres need to ensure that each candidate has satisfactorily met the requirements of the Performance Criteria in Outcomes 2, 3 and 4. Centres may wish to develop an appropriate checklist to record evidence that each candidate is satisfying the Performance Criteria.

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**